PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-199872
(43)Date of publication of application : 18.07.2000

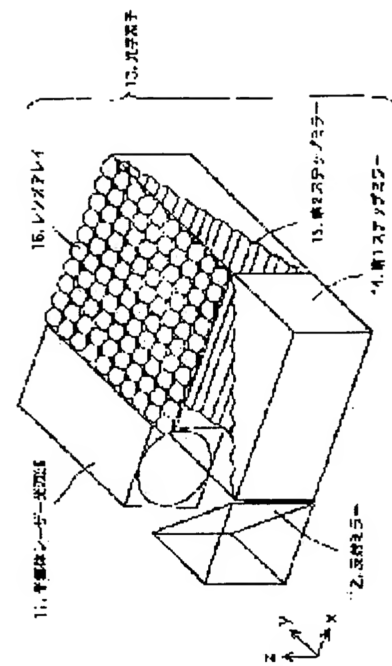
(51)Int.Cl. G02B 27/09
G02B 19/00
G02B 27/00
G02F 1/1335

(21)Application number : 10-377712
(22)Date of filing : 29.12.1998

(71)Applicant : SONY CORP
(72)Inventor : DOKO TORU

(54) ILLUMINATION DEVICE AND IMAGE DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To make it possible to reduce space coherence or to decrease speckles in spite of constitution which is compact and may be industrially mass produced.
SOLUTION: This illumination device has a first reflection member 14 having plural reflection surfaces with respectively have angles of inclination of approximately 45° with the optical axis of coherent incident light and are disposed to each other apart prescribed intervals in the optical axis direction of the incident light, a second reflection member 15 which respectively have angles of inclination of approximately 45° with the optical axis of the reflected light by the first reflection member 14 and are disposed to each other apart prescribed intervals in the optical axis direction of the incident light and a lens array member 16 having plural lenses which are disposed within the plane approximately perpendicular to the optical axis of the reflected light by this second reflection member 15.



LEGAL STATUS
[Date of request for examination]
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

* NOTICES *

JPO and INPIT are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The 1st reflective member which has the tilt angle whose each is 45 **** to the optical axis of coherent incident light, and has two or more reflectors mutually arranged in the direction of an optical axis of this incident light by separating predetermined spacing, The 2nd reflective member which has the tilt angle whose each is 45 **** to the optical axis of the reflected light by the reflective member of the above 1st, and has two or more reflectors mutually arranged in the direction of an optical axis of this incident light by separating predetermined spacing, the optical axis of the reflected light by the reflective member of the above 2nd -- receiving -- **** -- by having the lens array member and condenser lens which have two or more lenses arranged in the perpendicular field, and carrying out sequential reflection of the above-mentioned incident light in the 1st and 2nd reflective members The flux of light of this incident light is divided into two or more flux of lights which have a predetermined optical-path-length difference mutually. Make each flux of light of these plurality correspond to **** one to one, and it carries out incidence to each lens of the above-mentioned lens array member. The lighting system characterized by illuminating the same field of the irradiated plane arranged by making the above-mentioned condenser lens penetrate in the flux of light which penetrated each [these] lens in the focal location of this condenser lens.
[Claim 2] The optical-path-length difference of two or more flux of lights divided from incident light is a lighting system according to claim 1 characterized by the ******** rather than the coherence length of this incident light.
[Claim 3] It has the light source which emits the coherent incident light which carries out incidence to the 1st reflective member. Incident light has the periodic oscillation wavelength from which plurality differs, and expresses the degree of coherence of this incident light as a function of time amount. Set full width at half maximum of the 1st maximum wave form to tau 1, and distance between the maximal value with the 2nd maximum wave form which adjoins the 1st maximum wave form and the 1st maximum wave form is set to taud. When two or more reflectors which constitute the 1st reflective member are arranged at the fixed spacing d1 and two or more reflectors which constitute the 2nd reflective member are arranged at the fixed spacing d2, it is c(n-1) (taud+taut/2) <=d1<=c (ntaud-taut/2) about d1 and d2.
c(n-1) (taud+taut/2) <=d2<=c (ntaud-taut/2)
(-- however, the lighting system according to claim 1 characterized by, as for c, materializing the velocity of light, and materializing natural number), as for n.
[Claim 4] The 1st reflective section which has the tilt angle whose each is 45 **** to the optical axis of coherent incident light, and has two or more reflectors mutually arranged in the direction of an optical axis of this incident light by separating predetermined spacing, The 2nd reflective section which has the tilt angle whose each is 45 **** to the optical axis of the reflected light by this 1st reflective section, and has two or more reflectors mutually arranged in the direction of an optical axis of this incident light by separating predetermined spacing, the optical axis of the reflected light by this 2nd reflective section -- receiving -- **** -- with the optical element which has the lens array section which has two or more lenses arranged in the perpendicular field, and was formed in one By having a condenser lens and carrying out sequential reflection of the above-mentioned incident light in the 1st of the above-mentioned optical element, and the 2nd reflective section The flux of light of this incident light is divided into two or more flux of lights which have a predetermined optical-path-length difference mutually. Make each flux of light of these plurality correspond to **** one to one, and it carries out incidence to each lens of the above-mentioned lens array section. The lighting system characterized by illuminating the same field of the irradiated plane arranged by making the

above-mentioned condenser lens penetrate in the flux of light which penetrated each [these] lens in the focal location of this condenser lens.
[Claim 5] The optical-path-length difference of two or more flux of lights divided from incident light is a lighting system according to claim 4 characterized by the ******** rather than the coherence length of this incident light.
[Claim 6] It has the light source which emits the coherent incident light which carries out incidence to the 1st reflective section. Incident light has the periodic oscillation wavelength from which plurality differs, and expresses the degree of coherence of this incident light as a function of time amount. Set full width at half maximum of the 1st maximum wave form to tau 1, and distance between the maximal value with the 2nd maximum wave form which adjoins the 1st maximum wave form and the 1st maximum wave form is set to taud. When two or more reflectors which constitute the 1st reflective section are arranged at the fixed spacing d1 and two or more reflectors which constitute the 2nd reflective section are arranged at the fixed spacing d2, it is c(n-1) (taud+taut/2) <=d1<=c (ntaud-taut/2) about d1 and d2.
c(n-1) (taud+taut/2) <=d2<=c (ntaud-taut/2)
(-- however, the lighting system according to claim 4 characterized by, as for c, materializing the velocity of light, and materializing natural number), as for n.
[Claim 7] The 1st reflective member which has the tilt angle whose each is 45 **** to the optical axis of the coherent incident light which the light source emits, and has two or more reflectors mutually arranged in the direction of an optical axis of this incident light by separating predetermined spacing, The 2nd reflective member which has the tilt angle whose each is 45 **** to the optical axis of the reflected light by this 1st reflective member, and has two or more reflectors mutually arranged in the direction of an optical axis of this incident light by separating predetermined spacing, the optical axis of the reflected light by this 2nd reflective member -- receiving -- **** -- with the lens array member which has two or more lenses arranged in the perpendicular field Have a condenser lens and it divides into two or more flux of lights which have a predetermined optical-path-length difference for the flux of light of this incident light mutually by carrying out sequential reflection of the incident light in the 1st and 2nd reflective members. Make each flux of light of these plurality correspond to **** one to one, and it carries out incidence to each lens of a lens array member. The lighting section which illuminates the same field of the irradiated plane arranged by making a condenser lens penetrate in the flux of light which penetrated each [these] lens in the focal location of this condenser lens, It is the image display device which is equipped with the image display section which displays an image, and is characterized by the above-mentioned image display section being illuminated by the above-mentioned lighting section.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the image display device possessing a lighting system and this.
[0002]
[Description of the Prior Art] Conventionally, the liquid crystal panel which displays an image is illuminated as one gestalt of an image display device, and there is an optical projector constituted so that the reflected light or the transmitted light might be projected on a screen. In such a projector, lamps, such as metal halide, a halogen, or a xenon, are usually used as the light source. However, there are some following difficulties in such a source of a lamp light, and the utility value is barred.
[0003] In the first place, the life of a lamp is short, and, also in the case of a metal halide lamp, it is about 2,000 hours. For this reason, it must dedicate to the cartridge of an attachment-and-detachment type, and the device on the configuration of supposing that it is exchangeable must be given.
[0004] Furthermore, since the three primary colors of light are usually started and constituted from the white light from a lamp, there is also a difficulty that the volume becomes large by the optical system for it, and a color reproduction field is also restricted, and efficiency for light utilization also falls.
[0005] In order to solve these troubles, the attempt which uses OPTO semiconductor devices, such as light emitting diode or semiconductor laser, for the light source is also made. For example, generally in light emitting diode, the life is excellent with 10,000 hours or more. However, generally, its directivity of light is low, and since it emits and light emitting diode emits light, it is not easy to raise the use effectiveness of light.
[0006] Semiconductor laser can use efficiently the light emitted with the outstanding directivity at this point. Moreover, semiconductor laser is also fully long lasting and, generally energy use effectiveness is also larger than light emitting diode. Furthermore, semiconductor laser can take a large color reproduction field with the monochromaticity.
[0007]
[Problem(s) to be Solved by the Invention] However, when semiconductor laser was used as the light source like an above-mentioned projector, there was a problem of a speckle effect which is described below.
[0008] Generally, when a laser light source is used for the lighting of an image display device, on the image surface, for example, an observer's retina, it is possible that a body side, for example, each point of a screen, and the contribution from each field gather, and an image is formed. Under the present circumstances, since it is natural in a body front face that there is irregularity of the depth more than wavelength extent, the flux of light phase-related [complicated in the image surface] overlaps it, and if those flux of lights are coherent mutually, the pattern of complicated light and darkness will be produced as a result of interference. If this is a speckle and a display, it will become the cause which spoils image quality remarkably. Also in semiconductor laser, it has sufficient coherency to produce a speckle effect generally, and it becomes a problem.
[0009] Moreover, although the configuration of a laser scanning-type is also known as an option of image display using laser, a speckle effect poses a problem also in this case. Generally, the basic configuration of the image display device of a laser scanning-type condenses the outgoing radiation light from a laser light source with a lens, the spot is projected on one on a screen, a condensing spot will be scanned two-dimensional on a screen with the deflecting system arranged in an optical path, an image will be displayed, and human being will look at the transmitted light or the reflected light from the screen.
[0010] At this time, the flux of light in a condensing spot will lap in the image point with the random phase change in a screen in the image surface on a retina. In this way, the optical-path-length difference from the

light source of the flux of light which laps on a retina will be very small, it will interfere in it mutually, and a speckle will produce it.
[0011] A speckle effect is a problem common to the laser light source which has not only semiconductor laser but high coherence, and many attempts of solution have been performed from before. One of the typical approach of the is the approach of using a rotatory diffusion plate. This is the approach of fluctuating in time the speckle pattern produced in the image surface, and equalizing a pattern according to the storage effect within the speed of response of a light-receiving system by grinding between illuminated fields from the source of the illumination light, inserting a random diffusion plate like glass, and rotating it. For example, in the case of human being's eyes, the speed of response is called 30msec extent, and if a diffusion plate is rotated at sufficient rate to which a pattern is changed several times over in the time amount, a speckle pattern cannot carry out ******** recognition and can use it as human being's eyes.
[0012] However, since a rotatory diffusion plate originally has the operation which makes light emit, when it inserts in optical system, it will produce loss of incident light. Especially, in a laser scanning-type, after minding a rotatory diffusion plate, loss becomes with size to the quantity of light which can condense on a screen. Moreover, as for the rotatory diffusion plate rotated by the motor, it is not desirable as a noncommercial image display device to consume energy, in taking the volume, and to make a drive sound etc.
[0013] After the option which reduces a speckle effect divides into two or more flux of lights the coherent light which has a certain amount of coherence length and gives the optical path difference more than coherence length extent mutually, it is the approach of making it join or arrange again. The spatial degree of coherence of the coherent light joined or arranged can be reduced, so that there are many flux of lights divided, since this reduction approach serves as a non-coherent one between each flux of lights. The fiber bundle is known as a concrete known configuration. In this approach, the optical path difference longer than the coherence length of the light source which carries out incidence of two or more fibers to the die length of each fiber in a bundle is given. The both ends of a fiber are arranged, if incidence of the light is carried out from an end, in the other end, the outgoing radiation light from each fiber will serve as a non-coherent one mutually, and the spatial coherence as the whole will decrease. Therefore, when this is used as the light source of lighting etc., it is the approach that the speckle of an irradiated plane can be reduced.
[0014] However, there are the following troubles in the approach using a fiber bundle. For example, when 51 optical fibers are bundled and the difference of each die length is set to 1cm, the difference of the die length of the shortest optical fiber and the longest optical fiber is set to 50cm. And the both ends are arranged, for example, the ******** volume is required to dedicate in an image display device, and it becomes an inhibition factor when attaining the miniaturization of an image display device. Moreover, since the numerical aperture of the incidence edge of a fiber bundle is one or less, in case it combines with a fiber bundle the coherent light which carries out incidence, loss produces it. Furthermore, at an outgoing radiation edge, outgoing radiation of the flux of light is carried out from each fiber, namely, outgoing radiation light also becomes the cause which will consist of the flux of lights diverging from each point of outgoing radiation opening with a spreading area, and produces loss in latter optical system. Furthermore, it is fundamentally difficult to produce equipment like a fiber bundle in large quantities, and this is also unsuitable for a noncommercial image display device.
[0015] By the way, even if it uses a means to occur what kind of optical-path-length difference, there is a limitation in the coherence length of the coherent light by which outgoing radiation is carried out from the coherent light light source which has the power spectrum of a single mode reducing spatial coherence, since it is general sufficiently long. For example, when using the semiconductor laser of a single mode as the light source, the typical spectrum width of face is 100MHz, therefore coherence length becomes about 3m. Thus, the optical system which occurs the long optical path difference is a big inhibition factor when requiring the considerable volume and using for a noncommercial image display device.
[0016] Then, this invention is proposed in view of the above-mentioned actual condition, and though it is compact and is the configuration which can be mass-produced industrially, it tends to offer the image display device possessing the lighting system and this which enabled reduction of spatial coherence, or reduction of a speckle.
[0017]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the lighting system concerning this invention The 1st reflective member which has the tilt angle whose each is 45 **** to the optical axis of coherent incident light, and has two or more reflectors mutually arranged in the direction of an optical axis of this incident light by separating predetermined spacing, The 2nd reflective member which has the

tilt angle whose each is 45 **** to the optical axis of the reflected light by this 1st reflective member, and has two or more reflectors mutually arranged in the direction of an optical axis of this incident light by separating predetermined spacing, the optical axis of the reflected light by this 2nd reflective member -- receiving -- **** -- it has the lens array member and condenser lens which have two or more lenses arranged in the perpendicular field.

[0018] And this lighting system is characterized by dividing the flux of light of this incident light into two or more flux of lights which have a predetermined optical-path-length difference mutually, making each lens of a lens array member correspond to **** one to one, carrying out incidence of each flux of light of these plurality, and illuminating the same field of an irradiated plane through a condenser lens by carrying out sequential reflection of the incident light in the 1st and 2nd reflective members.

[0019] Moreover, the lighting system concerning this invention As opposed to the optical axis of the reflected light by the 1st reflective section which has the tilt angle whose each is 45 **** to the optical axis of coherent incident light, and has two or more reflectors mutually arranged in the direction of an optical axis of this incident light by separating predetermined spacing, and this 1st reflective section As opposed to the optical axis of the reflected light by the 2nd reflective section which has the tilt angle whose each is 45 ****, and has two or more reflectors mutually arranged in the direction of an optical axis of this incident light by separating predetermined spacing, and this 2nd reflective section **** -- it has the optical element which has the lens array section which has two or more lenses arranged in the perpendicular field, and was formed in one, and the condenser lens.

[0020] And by carrying out sequential reflection of the incident light of an optical element in the 1st and 2nd reflective sections, this lighting system divides the flux of light of this incident light into two or more flux of lights which have a predetermined optical-path-length difference mutually, makes each lens of the lens array section correspond to **** one to one, carries out incidence of each flux of light of these plurality, and is characterized by illuminating the same field of an irradiated plane through a condenser lens.

[0021] Furthermore, the image display device concerning this invention is equipped with an above-mentioned lighting system and the image display section which displays the image illuminated by this lighting system.

[0022] In the means mentioned above, the coherent light which carries out incidence is divided two-dimensional in a field perpendicular to the optical axis, and serves as two or more flux of lights in which the optical path difference occurred mutually. Moreover, each flux of light is arranged two-dimensional at the predetermined spacing, it passes one of the lenses which constitute a lens array respectively, and outgoing radiation is carried out. Two or more flux of lights by which outgoing radiation was carried out have the focal location of **** identitas, and result to an irradiated plane with the condenser lens arranged in the latter part. The flux of light which the irradiated plane was arranged in the backside [a condenser lens] focal location, namely, was each divided can irradiate the field of the **** identitas on a focal plane in that case. Therefore, by consisting of superposition of two or more flux of lights in which the optical path difference occurred mutually, and choosing the optical path difference suitably, the flux of light which results in one in an irradiated field can be mutually made incoherent, and can reduce the speckle in an irradiated plane.

[0023] Moreover, if the lighting system concerning this invention is used for an image display device, reduction of a speckle will enable it to obtain a high-definition image.

[0024] By the way, the coherent light which carries out incidence has the wavelength from which plurality differs, for example, when the semiconductor laser of a multimode is used for the light source, the operation explained below can be acquired. As the detail is shown in Japanese Patent Application No. No. 137823 [ten to], generally, it has two or more oscillation frequencies of fixed spacing decided by cavity length of laser, and, as for multimode laser, the degree of coherence which can be found from a power spectrum also shows the maximum of spin spacing. When full width at half maximum of the maximum wave form is set to taut and distance with the maximum wave form which adjoins a maximum wave form and it is set to taud, the optical path difference l of some 2 flux of lights is c {(n-1) taud+taut/2} <l<c (ntaud-taut/2).

******** -- if like -- the these 2 flux of light -- **** -- it is considered that it is incoherent and it hardly interferes. However, c is the velocity of light and n is the natural number. For example, in the case of multimode semiconductor laser, it is ctaud**0.5mm and about ctaut**4.0mm. Therefore, in this case, between 2 flux of lights, if a 3mm optical-path-length difference is made to occur, it can apply to the lighting system shown above, and reduction of a speckle can be aimed at effectively.

[0025]

[Embodiment of the Invention] This invention is applicable to the image display device possessing the lighting

system and this treating the coherent light by which outgoing radiation is carried out from the light source which emits coherent light, such as semiconductor laser.
[0026] Hereafter, the gestalt of the operation which applied this invention is explained with reference to a drawing.
[0027] [Gestalt 1 of operation] As shown in drawing 1 , the lighting system concerning this invention has the 2nd step mirror 15 which is the 1st step mirror 14 and the 2nd reflective member which are the 1st reflective member which constitutes an optical element 13, and the lens array 16, and is constituted.
[0028] Moreover, this lighting system has the semiconductor laser light source section 11 and the reflective mirror 12. The semiconductor laser light source section 11 consists of an optic which fabricates the beam of semiconductor laser and its outgoing radiation light, or a lens which collimates, and carries out outgoing radiation of the flux of light collimated by the **** round shape.
[0029] As shown in drawing 2 , when the degree of coherence also shows the maximum periodically by oscillating by two or more periodic oscillation frequencies and the so-called multimode as shown in drawing 3 , semiconductor laser sets full width at half maximum of the 1st maximum wave form to lt and distance between the maximal value with the 2nd maximum wave form which adjoins the 1st maximum wave form and the 1st maximum wave form is set to ld, it is lt**0.2mm and ld**4mm, for example.
[0030] 45 degrees of the optical axis are bent by the reflective mirror 12, and the outgoing radiation light from the semiconductor laser light source section 11 advances in the +x direction, and carries out incidence to an optical element 13. With reference to drawing 4 thru/or drawing 6 , the outline configuration of an optical element 13 is explained below. Incoming beams result in the 1st step mirror 14 which is the 1st reflective member which constitutes an optical element 13 first. The reflective mirror 42 which inclined 45 degrees to plane of incidence 41 is arranged in two or more parallel at ds1 spacing, and the 1st step mirror 14 is constituted, as shown in drawing 4 . Therefore, if 45 degrees of the optical axis are bent in the direction of +y and incoming beams are seen in a field perpendicular to the y-axis by the 1st snub mirror 14, they will be divided into the flux of light of the shape of a strip of paper arranged at ds1 spacing. Moreover, between the adjoining each flux of lights, when it sees from the light source, the optical path difference of ds1 has occurred.
[0031] Then, incidence of the divided flux of light is carried out to the 2nd step mirror 15 which is the 2nd reflective member. The reflective mirror 52 which inclines 45 degrees to plane of incidence 51 is arranged in two or more parallel at ds2 spacing, and the 2nd step mirror 15 is constituted, as shown in drawing 5 . Therefore, if 45 degrees of the optical axis are bent in the direction of +z by the 2nd step mirror 15 and the incident light divided in the shape of a strip of paper is seen in a x-y side perpendicular to the z-axis, it will be divided into the flux of light of the shape of a grid which arranges at ds1 spacing in the x directions, and is arranged at ds2 spacing in the direction of y.
[0032] Moreover, between each flux of light, the optical path difference which made ds1 and ds2 the unit has occurred. In the x-y side, the lens array 16 is arranged further. As the lens array 16 is shown in drawing 6 , two or more lenses consist of two or more lenses periodically arranged at ds2 spacing in ds1 and the direction of y in the x directions. To one of the lenses in the lens array 16, corresponding to one to one, each carries out incidence of the flux of light divided by the 1st snub mirror 14 and the 2nd step mirror 15, and penetrates it.
[0033] The flux of light which penetrated each lens of the lens array 16 illuminates the same field of the irradiated plane arranged in the focal location of this condenser lens through a condenser lens.
[0034] After all, among two or more flux of lights which penetrate the lens array 16, the optical path difference which made ds1 and ds2 the unit has occurred, and if [2 / ds1 and / ds] ld+lt(m-1)/2 <=ds1 <=mld-lt/2 (m-1) ld+lt/2 <=ds2 <=mld-lt/2, each flux of light can be mutually made incoherent. However, m is the natural number here.
[0035] [Gestalt 2 of operation] The lighting system concerning this invention may constitute the 1st step mirror section 74, the 2nd step mirror section 75, and the lens array section 76 as a single transparent optical element again, as shown in drawing 7 .
[0036] The semiconductor laser light source section 71 is the same as that of the semiconductor laser light source section 11 shown by drawing 1 , collimates and carries out outgoing radiation of the coherent light of a multimode, and it is made it to carry out incidence to an optical element 73 through the reflective mirror 72.
[0037] It is the optical element of the transparent shape of single prism which has the 1st step mirror section 74, the 2nd step mirror section 75, and the lens array section 76, and you may produce in one, and a refractive index may be adjusted, may be made to rival and the components which have each part may be made, as for an optical element 73, to unify. An optical element 73 has the outside section of the same configuration as the

reflector of an above-mentioned step mirror, and has fundamentally the same operation as the optical element 13 shown by drawing 1 . That is, from the lens array section 76, outgoing radiation of two or more divided flux of lights is carried out. However, between each flux of light, supposing the refractive index of the ingredient which constitutes an optical element 73 is uniform and n, the optical path difference which made nds1 and nds2 the unit has occurred. About nds1 and nds2, if ld+lt(m-1)/2 <=nds1 <=mld-lt/2 (m-1) ld+lt/2 <=nds2 <=mld-lt/2, each flux of light can be mutually made incoherent.
[0038] Also in this optical element, the flux of light which penetrated each lens of the lens array section 76 illuminates the same field of the irradiated plane arranged in the focal location of this condenser lens through a condenser lens.
[0039] In addition, it can mass-produce at low cost, such as unifying an optical element and carrying out injection molding like the gestalt of this operation, using a detail part, then metal mold, and is industrially advantageous. Moreover, although it is important that the transmission of the transparence optical element 73 is high to the wavelength of incident light in this case, organic materials, such as others, polycarbonate resin, polymethylmethacrylate resin, etc., can be used. [optical glass /, such as silica glass,]
[0040] moreover, these optical materials -- general -- 1 -- size -- the case where it considers as the configuration whose flux of light spreads the inside of air as shown in drawing 1 since it has a refractive index n -- a ratio -- if it is BE and the same magnitude, an optical-path-length difference can be made more into size. Conversely, if it says, magnitude of the whole equipment can be made small.
[0041] Furthermore, this optical element can also unite the transparence optical element 73 with the optic for beam-fabricating or collimating the outgoing radiation light from the semiconductor laser in the reflective mirror 72 and the semiconductor laser light source section 71 etc., and can also reduce components mark further.
[0042] [Gestalt 3 of operation] Further, the lighting system concerning this invention can constitute an image display device, as shown in drawing 8 .
[0043] It is condensed for every element lens and the flux of light which carried out outgoing radiation of the lens array of the lighting system 81 which consists of an above-mentioned configuration results in a condenser lens 82. The irradiated plane 83 is arranged in the backside [a condenser lens 82] focal plane.
[0044] Therefore, the flux of light which carried out outgoing radiation of each lens array will irradiate the field of the **** identitas on an irradiated plane. Conversely, if it says, the flux of light which results in one on an irradiated plane 83 will consist of superposition of the flux of light which became incoherent mutually according to the optical path difference which occurred in the lighting system 81, and can reduce the speckle in an irradiated plane 83.
[0045] Moreover, since a lighting system 81 makes the flux of light of the source of coherent light which carries out incidence divide in a field perpendicular to an optical axis, even if it is [intensity distribution] uneven, the intensity distribution in respect of [illuminated] are averaged and equalized so that clearly from drawing 6 . Furthermore, although an illuminated field generally serves as a rectangle, the aspect ratio can be designed to arbitration by choosing suitably the mirror length of the 1st step mirror (part) of a lighting system 81, and the mirror length of the 2nd step mirror (part). That is, when the 1st same step mirror as the optical element shown in the lighting system 81 by drawing 1 , drawing 4 , and drawing 5 and the 2nd step mirror are used, the aspect ratio of a lighting field can be designed to arbitration by choosing dm1 and dm2 suitably.
[0046] Moreover, in order to constitute the image display device possessing the lighting system concerning this invention, the space optical modulator of liquid crystal can be arranged in the irradiated plane 83 shown in drawing 8 , and it can also consider as the configuration which projects the transmitted light or reflected light on a screen with a projection lens, and displays an image.
[0047] In addition, although the semiconductor laser of the multimode oscillated on two or more frequencies was used as the light source with the gestalt of above-mentioned operation, multimode semiconductor laser is good as what has the oscillation wavelength of original plurality, and is obtained also by carrying out weight of the RF signal to the inrush current of the semiconductor laser originally oscillated on single wavelength. Generally, the semiconductor laser of such a multimode has small lt, and the configuration for acquiring the effectiveness of the speckle reduction mentioned above is comparatively easy for it. However, if it is not restricted to the semiconductor laser of a multimode and the same principle is used as a source of coherent light, it is applicable to the general laser light source which is a source of coherent light.
[0048]
[Effect of the Invention] As mentioned above, since according to the lighting system and image display device concerning this invention an optical-path-length difference occurs while incident light is divided into two or

more flux of lights though it is a cheaply producible configuration that it is small and in large quantities, the spatial coherence of an exit light surface can be reduced effectively.

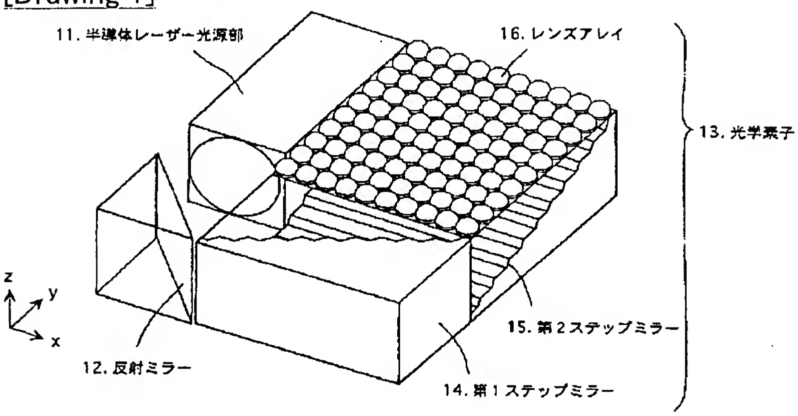
[0049] Moreover, if the multimode laser which has the oscillation wavelength from which plurality differs is used for the light source, optimization of an optical-path-length difference can be attained using the periodic degree of coherence, and reduction of spatial coherence can be aimed at effectively.

[0050] Moreover, since according to the lighting system concerning this invention an optical-path-length difference occurs and outgoing radiation is carried out through a lens for every flux of light while incident light is divided into two or more flux of lights, the uniform lighting with which SU ** KKURU was reduced can be offered. Therefore, in the image display device possessing this lighting system, time and effort, such as highly precise positioning, is not needed by small components mark, but it is small and it becomes possible to offer the image of high quality with which the speckle effect was reduced.

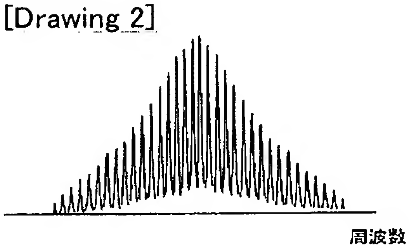
[Translation done.]

DRAWINGS

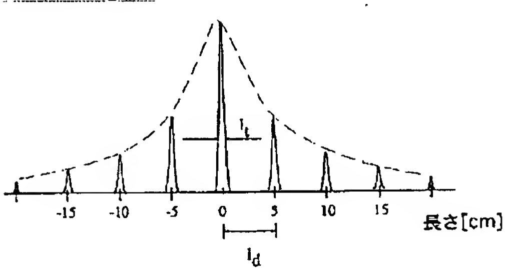
[Drawing 1]



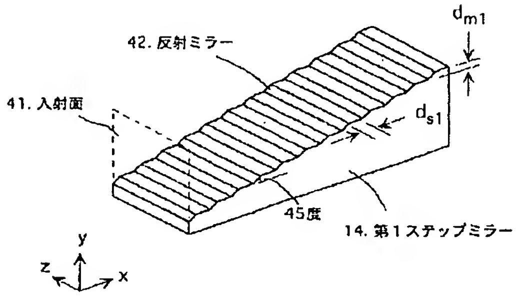
[Drawing 2]



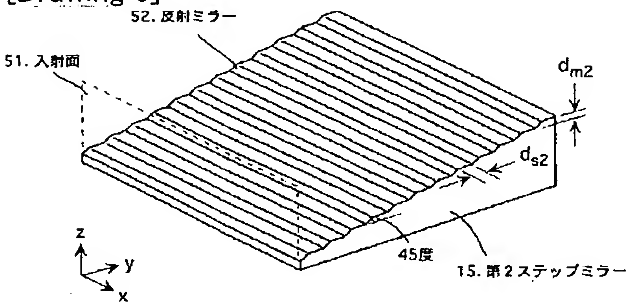
[Drawing 3]



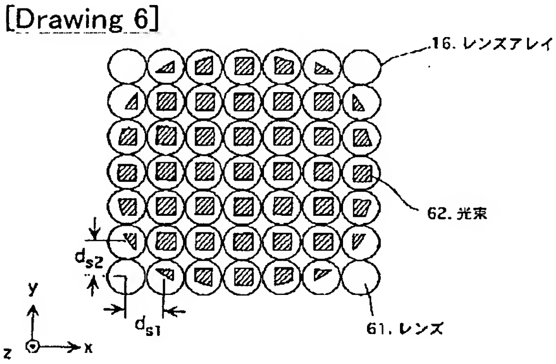
[Drawing 4]



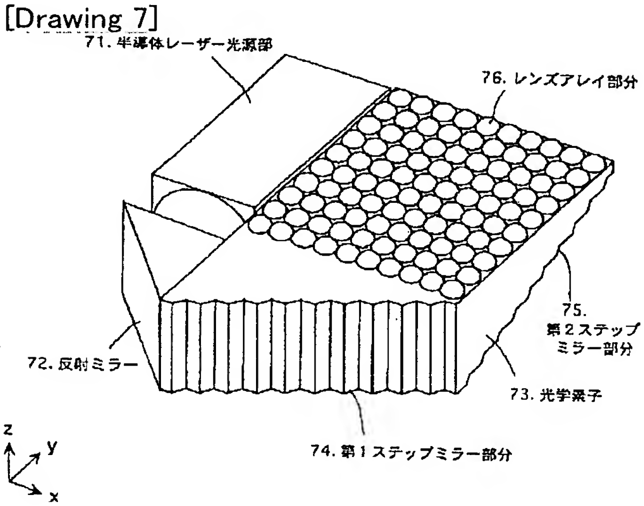
[Drawing 5]



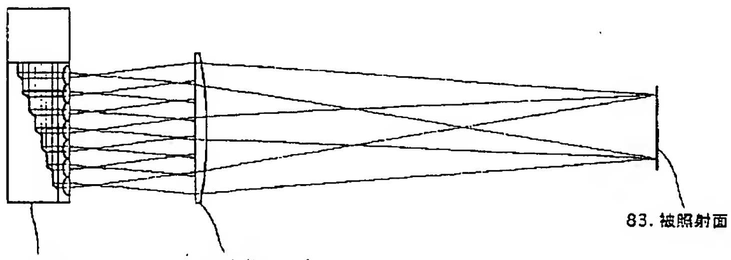
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]